PATENT ABSTRACTS OF JAPAN

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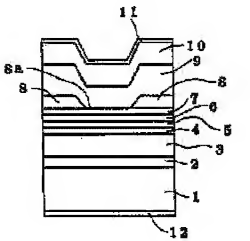
(54) SEMICONDUCTOR LASER DEVICE

(57)Abstract:
PURPOSE: To provide a semiconductor laser device which ensures high output and long life.
CONSTITUTION: A semiconductor layer comprising an active layer 5 having distorted quantum well structure, which is composed of an InGaAs well layer and an AlGaAs barrier layer, is formed on an n-type GaAs substrate. Particularly, the concentration of impurities in the active layer 5 is preferably set at 2×1017cm-3 or below.



DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to a semiconductor laser device with the active layer of distortion quantum well structure.
[0002]
[Description of the Prior Art]In recent years, the semiconductor laser device which outputs the light of wavelength 780 nm band is used as light sources, such as a compact disk (CD) and an optical disk unit. However, since optical power was small, it was used for read-out, but the conventional semiconductor laser device was not able to be used as an object for writing.
[0003]Also when a semiconductor laser device was used as the light source for high density recording combined with the SHG element, a light source for communication, etc., there was a problem that optical power was small.
[0004]As window structure is provided in the end face of a semiconductor laser device by which optical power is carried out in order to solve this problem, and indicated by 27 page [879th] p-ZG-4 of for example, the collection (1989) of the 50th Japan Society of Applied Physics academic lecture meeting drafts, The method of using GaAs(well layer)/AlGaAs (barrier layer) quantum well structure as an active layer is known.
[0005]
[Problem(s) to be Solved by the Invention]However, in the semiconductor laser device of the above structures, there was a problem that the life in the operating state which carried out the high optical output was short.
[0006]This invention is accomplished in view of an above-mentioned problem, and it is the purpose to provide a high optical output and a long lasting semiconductor laser device.
[0007]
[Means for Solving the Problem]A semiconductor laser device of this invention has an active layer of

distortion quantum well structure which consists of an InGaAs well layer and an AlGaAs barrier layer on a GaAs substrate.

[0008]In particular, it is characterized by impurity concentration of said active layer being below 2x10 $^{17}cm^{-3}$.

[0009]

[Function]If the distortion quantum well structure which consists of an InGaAs well layer and an AlGaAs barrier layer is used as an active layer of a semiconductor laser device, high-optical-output-izing and reinforcement are realizable, and it is effective when especially impurity concentration of an active layer is made below into 2x10 $^{17}cm^{-3}$.

[0010]

[Example]One example concerning this invention is described using a drawing. Drawing 1 is a sectional view of the semiconductor laser device of this example, and cavity length is 600 micrometers.

[0011]One is a n type GaAs substrate among a figure. . It is the upper surface of this n type substrate 1. On a field, (100) The n type aluminum$_{0.4}$Ga$_{0.6}$As cladding layer (Si-dope concentration: 3x10 $^{17}cm^{-3}$) 3 of 2 or 1 micrometer of n type GaAs buffer layer (Si-dope concentration: 1x10 $^{18}cm^{-3}$) thickness of 0.5-micrometer thickness, And the n type aluminum$_{0.3}$Ga$_{0.7}$As cladding layer (Si-dope concentration: 1x10 $^{17}cm^{-3}$) 4 of 300A thickness is formed in this order.

[0012]On said n type clad layer 4, the active layer 5 of the multiplex quantum well (MQW) structure laminated by turns so that it might become a mode in which an aluminum$_{y}$Ga$_{1-y}$As barrier layer and an In$_{x}$Ga$_{1-x}$As well layer with compressive strain **** a well layer by a barrier layer is formed. Below 2x10 $^{17}cm^{-3}$ of the impurity concentration of this active layer 5 is good, and it is desirable that it is especially a undoped type. For example, as shown in drawing 2, this active layer 5 can use the undoped type active layer which the aluminum$_{0.3}$Ga$_{0.7}$As barrier layer 5a of 70A thickness and the In$_{0.03}$Ga$_{0.97}$As well layer 5b of 30A thickness are laminated by turns, and comprises nine layers and eight layers, respectively.

[0013]On said active layer 5, the p type aluminum$_{0.3}$Ga$_{0.7}$As cladding layer 6 (Be dope concentration: 1x10 $^{17}cm^{-3}$) of 300A thickness, And the p type aluminum$_{0.4}$Ga$_{0.6}$As cladding layer 7 (Be dope concentration: 7x10 $^{17}cm^{-3}$) of 0.2-micrometer thickness is formed.

[0014]On said p type clad layer 7, the n type GaAs current stricture layer (Si-dope concentration: 1x10 $^{18}cm^{-3}$) 8 of 0.7-micrometer thickness is formed, The slot 8a of stripe shape with a width [for exposing said cladding layer 7] of 4 micrometers is formed in this current stricture layer 8 in accordance with the [01-1] direction.

[0015]Said exposed p type clad layer 7. On the current stricture layer 8, and the p type

aluminum$_{0.4}$Ga$_{0.6}$As cladding layer (Be dope concentration: 1x10 ^{18}cm^{-3}) 9 of 1-micrometer thickness, And the p type GaAs cap layer (Be dope concentration: 1x10 ^{19}cm^{-3}) 10 of 1-micrometer thickness is formed in this order.

[0016]The n type electrode 12 which consists of the p type electrode 11 which consists of Au/Cr, respectively, and Au/Sn is formed in said cap layer 10 upper surface and said n type substrate 1 undersurface.

[0017]This semiconductor laser device could be conventionally manufactured with well-known layering technique, etching technology, etc., for example, substrate temperature formed all the semiconductor layers including the active layer of MQW structure under the conditions which are 650 ** by the molecular beam epitaxy (MBE) method or the organic-metal-vapor-growth (MOCVD) method.

[0018]The **** semiconductor laser device oscillated the light of the wavelength 780 nm band by high power. Drawing 3 shows the relation between the survival rate of the semiconductor laser device of the **** structure after 1000-hour operation, and the impurity concentration of an active layer under the state of 30 mW of optical power which is 50 ** and a high optical output. However, cavity length is 600 micrometers and 8% and 80% of coating is performed for reflectance to a front face and the back among the optical power end faces, respectively. Here, Be (or Si) was used as an impurity.

[0019]This figure to impurity concentration is a survival rate high at below 2x10 ^{17}cm^{-3}, and it turns out that it becomes a high survival rate of about 90% especially in below 1x10 ^{17}cm^{-3}. Thus, it is thought of because the quantum well structure (potential structure) at the time of operation (at the time of energization) can be held by control of said impurity concentration by making impurity concentration of said active layer below into 2x10 ^{17}cm^{-3} to be made to a high survival rate.

[0020]Although the oscillation was wavelength 780 nm band in the above-mentioned example, an oscillation with a wavelength [other than wavelength 780 nm band] of about 750-980 nm can also be performed by choosing the thickness or the composition ratio x of an In$_x$Ga$_{1-x}$As well layer which constitutes the active layer of MQW structure.

[0021]As mentioned above, life-span can be made high-powered and extended by making an active layer into the distortion quantum well structure which consists of an InGaAs well layer and an AlGaAs barrier layer. It is desirable that below 2x10 ^{17}cm^{-3} carries out impurity concentration of said active layer especially. A undoped type is desirable although p and a n type may be sufficient as an active layer.

[0022]In ****, although the n type GaAs substrate was used as a substrate, the conductivity type of a cladding layer, a cap layer, and a current stricture layer may be made reverse using a p type GaAs substrate.

[0023]If one of the impurity concentration of a well layer or a barrier layer is below 2x10 ^{17}cm^{-3} at least, there is an effect of a high increase in power and reinforcement.

[0024]

[Effect of the Invention]since the semiconductor laser device of this invention has a semiconductor layer containing the active layer of the distortion quantum well structure which consists of an InGaAs well layer and an AlGaAs barrier layer -- high power -- and life-span is extended. Since the impurity concentration of said active layer carries out especially below in $2x10^{17}cm^{-3}$, it is more effective.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a sectional view showing the section of the semiconductor laser device of one example concerning this invention.
[Drawing 2]It is an enlarged drawing of the active layer of said semiconductor laser device.
[Drawing 3]It is a figure showing the relation between the survival rate of said semiconductor laser device, and the concentration of an active layer.
[Description of Notations]
5 Active layer
5a Barrier layer
5b Well layer

[Translation done.]